WE CLAIM

1. A method of operating a communication system comprising:

providing a channel matrix of a gain and phase between each transmit antenna and each receive antenna of the communication system;

computing at least one receive weight vector as a function of the channel matrix and at least one transmit weight vector; and

computing an updated transmit weight vector as a function of the transmit weight vector, the receive weight vector and the channel matrix.

2. The method of claim 1 further comprising computing a gradient matrix as a function of the transmit weight vector, the channel matrix, the receive weight vector and a constraint weight, computing the updated transmit weight vector as a function of the gradient matrix and the transmit weight vector.

3. The method of claim 1 wherein the transmit weight vector is computed as a function of a step size.

4. The method of claim 1 wherein the updated transmit weight vector is computed according to:

$$\min_{\mathbf{w}_u, \mathbf{v}_u} \sum_{u=1}^{N_s} \mathrm{E}\left|r_u - x_u\right|^2 = \min_{\mathbf{w}_u, \mathbf{v}_u} \sum_{u=1}^{N_s} \mathrm{E}\left|\mathbf{w}_u^H\left(\sum_{\ell=1}^{N_s} \mathbf{H}\mathbf{v}_\ell x_\ell + \mathbf{n}\right) - x_u\right|^2,$$

where r_u is the u^{th} element of **r** and x_u is u^{th} element of **x**.

5. The method of claim 2 wherein each column of the gradient matrix is computed according to:

$$\mathbf{G} = \left(\mathbf{H}^H \mathbf{W}\mathbf{W}^H \mathbf{H} + 2\gamma(\text{trace}(\mathbf{V}^H \mathbf{V}) - 1)\mathbf{I}_{M_T}\right)\mathbf{V} - \mathbf{H}^H \mathbf{W}\,.$$

6. The method of claim 1 wherein the updated transmit weight vector is computed according to:

$$\min_{\mathbf{w}_u, \mathbf{v}_u} \sum_{u=1}^{N_s} E\left|r_u - x_u\right|^2 = \min_{\mathbf{w}_u, \mathbf{v}_u} \sum_{u=1}^{N_s} E\left|\mathbf{w}_u^H\left(\sum_{\ell=u}^{N_s} \mathbf{H}\mathbf{v}_\ell x_\ell + \mathbf{n}\right) - x_u\right|^2$$

, where r_u is the u^{th} element of **r** and x_u is u^{th} element of **x.**

7. The method of claim 2 wherein each column of the gradient matrix is computed according to:

$$\nabla \mathbf{v}_u = \left(\sum_{\ell=1}^{u} \mathbf{H}^H \mathbf{w}_\ell \mathbf{w}_\ell^H \mathbf{H} + 2\gamma(\text{trace}(\mathbf{V}^H \mathbf{V}) - 1)\mathbf{I}_{M_T}\right)\mathbf{v}_u - \mathbf{H}^H \mathbf{w}_u\,,$$

where u designates a column of the gradient vector.

8. A system for operating a communication system comprising:

means for providing a channel matrix of a gain and phase between each transmit antenna and each receive antenna of the communication system;

means for computing at least one receive weight vector as a function of the channel matrix and at least one of transmit weight vectors; and

means for computing an updated transmit weight vector as a function of the transmit weight vector, the channel matrix, and the receive weight vector.

9. The system of claim 8 further comprising means for computing a gradient matrix as a function of the channel matrix, the receive weight vector, the transmit weight vector and a constraint weight, means for computing the updated transmit weight vector as a function of the gradient matrix and the transmit weight vector.

10. The system of claim 8 further comprising means for computing the transmit weight vector as a function of a step size.

11. A computer readable medium storing a computer program comprising:

computer readable code for providing a channel matrix of a gain and phase between each transmit antenna and each receive antenna of the communication system;

computer readable code for computing at least one receive weight vector as a function of the channel matrix and at least one of transmit weight vectors;

computer readable code for computing a gradient matrix as a function of the channel matrix, the receive weight vector and the transmit weight vector; and

computer readable code for computing an updated transmit weight vector as a function of the transmit weight vector and the gradient vector.

12. The program of claim 11 further comprising computer readable code for computing a gradient matrix as a function of the transmit weight vector, the channel matrix, the receive weight vector and a constraint weight, computing the updated transmit weight vector as a function of the gradient matrix and the transmit weight vector.

13. The program of claim 11 further comprising computer readable code for computing the transmit weight vector as a function of a step size.

14. The method of claim 11 wherein the updated transmit weight vector is computed according to:

$$\min_{\mathbf{w}_u,\mathbf{v}_u} \sum_{u=1}^{N_s} \mathrm{E}\left|r_u - x_u\right|^2 = \min_{\mathbf{w}_u,\mathbf{v}_u} \sum_{u=1}^{N_s} \mathrm{E}\left|\mathbf{w}_u^H\left(\sum_{\ell=1}^{N_s}\mathbf{H}\mathbf{v}_\ell x_\ell + \mathbf{n}\right) - x_u\right|^2,$$

where r_u is the u^{th} element of **r** and x_u is u^{th} element of **x.**

15. The program of claim 12 wherein each column of the gradient matrix is computed according to:

$$\mathbf{G} = \left(\mathbf{H}^H\mathbf{W}\mathbf{W}^H\mathbf{H} + 2\gamma(\mathrm{trace}(\mathbf{V}^H\mathbf{V}) - 1)\mathbf{I}_{M_T}\right)\mathbf{V} - \mathbf{H}^H\mathbf{W}.$$

16. The program of claim 11 wherein the updated transmit weight vector is computed according to:

$$\min_{\mathbf{w}_u,\mathbf{v}_u} \sum_{u=1}^{N_s} \mathrm{E}\left|r_u - x_u\right|^2 = \min_{\mathbf{w}_u,\mathbf{v}_u} \sum_{u=1}^{N_s} \mathrm{E}\left|\mathbf{w}_u^H\left(\sum_{\ell=u}^{N_s}\mathbf{H}\mathbf{v}_\ell x_\ell + \mathbf{n}\right) - x_u\right|^2,$$

where r_u is the u^{th} element of **r** and x_u is u^{th} element of **x.**

17. The program of claim 12 wherein each column of the gradient matrix is computed according to:

$$\nabla\mathbf{v}_u = \left(\sum_{\ell=1}^{u}\mathbf{H}^H\mathbf{w}_\ell\mathbf{w}_\ell^H\mathbf{H} + 2\gamma(\mathrm{trace}(\mathbf{V}^H\mathbf{V}) - 1)\mathbf{I}_{M_T}\right)\mathbf{v}_u - \mathbf{H}^H\mathbf{w}_u,$$

where u designates a column of the gradient vector.

18. A method of operating a communication system comprising computing a plurality of transmit weight vectors and a plurality of receive weight vectors that minimizes an expected mean squared error between analytical successive cancellation symbol estimates and transmitted symbols.

19. The method of claim 18 wherein each analytical successive cancellation symbol estimate is computed according to:

$$r_u = \mathbf{w}_u^H\left(\mathbf{y} - \sum_{\ell=1}^{u-1}\mathbf{H}\mathbf{v}_\ell \hat{x}_\ell\right), \text{ where } \hat{x}_\ell = slice(r_\ell)$$

20. The method of claim 18 wherein the transmit weight vector is normalized according to:

$$\text{trace}(\mathbf{V}^H\mathbf{V}) = 1$$

21. A method of operating a communication system comprising computing a plurality of transmit weight vectors wherein the transmit weight vectors are computed according to:

$$\mathbf{V} = \mathbf{U}_V\mathbf{S}_V\mathbf{Z}_V^H$$

where $\mathbf{U}_V = \mathbf{Z}_H$ and $\mathbf{Z}_V$ is chosen according to:

$$\mathbf{Z}_{V,\ell}^H\tilde{\mathbf{D}}\mathbf{Z}_{V,\ell} = 1 - \overline{MSE} = \text{trace}(\tilde{\mathbf{D}})/\text{N}_s$$

subject to $\mathbf{Z}_V\mathbf{Z}_V^H = \mathbf{Z}_V^H\mathbf{Z}_V = \mathbf{I}_{N_s}$

22. The method of claim 21 wherein the right singular vectors of the transmit weight matrix are the columns of the normalized DFT matrix.

23. The method of claim 21 wherein the right singular vectors of the transmit weight matrix are the columns of the normalized Hadamard matrix.